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Iron Ore and Coking Coal Resources in Northwest
and Southwest China

Project Number: 23.3722

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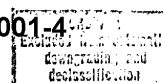
I. Foreword

This memorandum summarizes and evaluates the iron ore and coking coal reserve position of western China with particular emphasis on the present state of development and possibility for future growth. The report should be of value to the intelligence community in view of the multitude of fanciful announcements made by the Chinese, particularly during the "Leap Forward" period, concerning the size of the country's raw material base.

Although pre-1949 information on mineral reserves in northwest and southwest China is limited, two studies were used as bench marks, where possible, for judging the validity of Communist claims concerning discoveries of large new reserves. These studies, prepared by the US Department of Interior for the Chief of Engineers, US Army, in 1945 and by the Arthur G. McKee Company, Cleveland, Ohio, for the National Resources Commission of China in 1946, were concerned principally with defining iron and steel industry resources in eastern and central China but did contain considerable peripheral information on raw materials in western China.

Additional material used for evaluating Chinese claims include a limited number of useful defector reports which have become available in recent years, several short studies by the American Consul General, Hong Kong, and aerial photography flown in 1962 over portions of this

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part of China. The latter proved valuable in a number of cases by confirming the existence of new or expansion of old mines and plants.

II. Introduction

Before 1949, iron ore reserves in China, based principally on deposits surveyed by the Japanese near the coast, were placed at about 2.8 billion tons. Although no aggregate figure for coking coal reserves was reported, extensive reserves were known to exist, principally north of the Yangtse river in north and northeast China. Little prospecting for or mining of iron ore or coking coal had been carried out in western China prior to the Communist takeover due to the absence of any iron and steel facility of significance in the region and the mountainous inaccessible terrain characteristic of much of the area. Moreover, outside of the more densely populated districts, transportation facilities were quite primitive consisting in many cases of traditional caravan trails.

The first Communist organized effort for measuring China's iron ore resources was made in connection with the First Five Year Plan (1953-57). Primary emphasis was placed on surveying the proposed locations for major blast furnace facilities in the central and eastern parts of the country although considerable attention also was given to establishing the extent of possible reserves in western China. By the end of the First Plan the Chinese claimed total potential reserves of iron ore

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amounted to 15.9 billion tons of which by 1960, midway through the Second Five Year Plan (1958-62), claimed proved reserves amounted to 10 billion tons. Potential reserves of 15.9 billion tons would rank China second in the Bloc and possibly sixth in the world in iron ore resources.

As with iron ore, the first concerted effort by the Communists to determine the extent of coking coal resources in western China was initiated with the First Five Year Plan. As a result of surveys during the 1953-57 period and during at least the first three years of the Second Plan additional reserves were discovered in the previously known north and northeast areas and large new deposits were reported in Kwangtung in south China and in Kansu and Kweichow in northwest and southwest China, respectively.

III. Summary and Conclusions

Although largely low grade, reserves of iron ore and coking coal in northwest and southwest China probably are more than adequate to support anticipated iron and steel industry requirements including those of a large steel mill scheduled for ultimate construction in each area.* The adequacy of the reserves, however, will be dependent to a considerable extent upon the construction of new rail facilities and, more importantly, the installation of sufficient beneficiating capacity to provide raw materials of a commercially acceptable quality.

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No figures have ever been released concerning total resources of iron ore in western China and estimates of provincial reserves have been released on only Shensi in the northwest and Szechwan and Yunnan in the southwest. Nevertheless, data that are available on individual deposits indicate total reserves of iron ore in this region may amount to as much as 2.7 billion tons with approximately three-fourths of the total occurring in the southwest. Iron ore resources of this magnitude are equal to roughly one-fifth of the total claimed potential reserves in China and include significant new deposits proved at Chih^N-tieh-shan (39°15'N; 98°45'E) in Kansu province and at Pan-chih-hua (26°29'N; 101°44'E) in Szechwan province both of which are sites for planned major iron and steel plants. However, except for a few scattered high grade deposits, the most important being a 100 million ton reserve of limonite in western Kweichow province, most of the ore is poor in quality with an iron content ranging from 30 to 50 percent. Moreover, since development of many of the reserve areas has been limited to preliminary survey work any large scale exploitation will require extensive investment in site preparation including the installation of mining and dressing equipment to provide ore of a grade suitable for economic use in the blast furnace.

* Iron ore and coking coal mines and deposits in western China are located on the maps, figures 1 and 4, and are described in Appendices A and B.

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Due to the geographic isolation of much of western China, a substantial number of small native iron plants long have provided iron for local use in producing primitive tools and agricultural implements. The only iron and steel facilities of significance in this region before 1957 were four small plants that comprised the Chungking Iron and Steel Company in Szechwan. During the 1958-60 period, however, in conjunction with the rapid buildup of capacity elsewhere in China, many new small and a few medium blast furnaces were constructed. In 1960, based on estimated provincial totals, output of pig iron (most of which was poor quality) amounted to a maximum of about 3.9 million tons--slightly less than 15 percent of the claimed national production of 27.5 million tons of pig iron in that year. To keep pace with the expanded iron production during this period output of iron ore was raised by enlarging existing and opening a number of new mines which, with a few exceptions, were small, labor-intensive, open-pit operations. In addition, particularly in Szechwan and Yunnan provinces in the southwest, a limited amount of ore dressing capacity was installed. The subsequent deterioration of the domestic economy during 1961-62 accompanied by the closure of most of the country's small iron and steel plants has resulted in output of iron ore being at nominal levels throughout most of western China since 1960.

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Although no overall figure for coking coal reserves in west China has been released, existing information indicates that portion of the country's estimated 60 billion tons of bituminous coal of coking quality ^{the portion} which occurs in this area probably is adequate to satisfy the requirements of the ~~highest probable growth rate in the~~ region's iron and steel industry. Significantly, however, a large portion of the coal is high in sulphur and ash and requires considerable preliminary preparation to allow production of a satisfactory quality coke. In this connection, a number of coalwashing facilities have been constructed by the Chinese, particularly in Szechwan where the only modern byproduct coking capacity in western China is located.

Production of coke in northwest and southwest China climbed from minimal levels that prevailed before 1957 to a possible annual maximum of about 5 million tons in 1960--principally as a result of the large scale construction of "Red Flag,"* beehive, and native coking facilities associated with small iron and steel plants. Only about 10 percent of the region's 1960 coke output, or approximately 500,000 tons, was produced in modern byproduct facilities all of which are located in the Chungking district. Coke output in western China since 1960, has been restricted principally to the small amount needed by the nonferrous industry and the limited quantity needed to support the sharply reduced levels of iron and steel production.

* "Red Flag" coke ovens are semi-mechanized ovens capable of recovering byproducts. The capacity of the No. 2 oven is 5,000 tons per year and that of a No. 3 oven is 10,000 tons per year.

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IV. Iron Ore and Coking Coal Resources in Northwest and Southwest China

A. Northwest China

1. Kansu (including Ningsia Autonomous Region)

a. Iron Ore

Very little iron ore prospecting had been carried out in Kansu prior to the Communist takeover. In 1955, the Chinese with Soviet assistance began an organized search for iron resources in the province, concentrating their survey activities primarily in that portion of Kansu known as the Ho-hsi corridor and in the Ch'i-lien mountains which make up much of the southwestern wall of the corridor. In late 1955, the Communists announced that the largest iron ore deposit in northwest China had been discovered at Chi^N-tieh-shan (39°15'N; 98°45'E) on the northern slopes of the Ch'i-lien mountains. 1/ See photograph, Figure 2. The reserve area consists of a claimed 300 million tons of hematite iron ore containing about 40 percent iron. Based on these reserves, which constitute over 90 percent of total known iron ore resources in Kansu, the Chinese in 1958 began construction of a major iron and steel plant in the city of Chiu-ch'uan (39°46'N; 98°34'E) located on the Lanchow-Sinkiang railroad about 50 miles north of the mine. Construction of a spur rail line from Chiu-ch'uan to the mining area was started in 1958, although, as of the end of 1962 its completion had not been confirmed. The mining area is served by a truck road that runs south through the Ch'i-lien mountains into Tsinghai province.

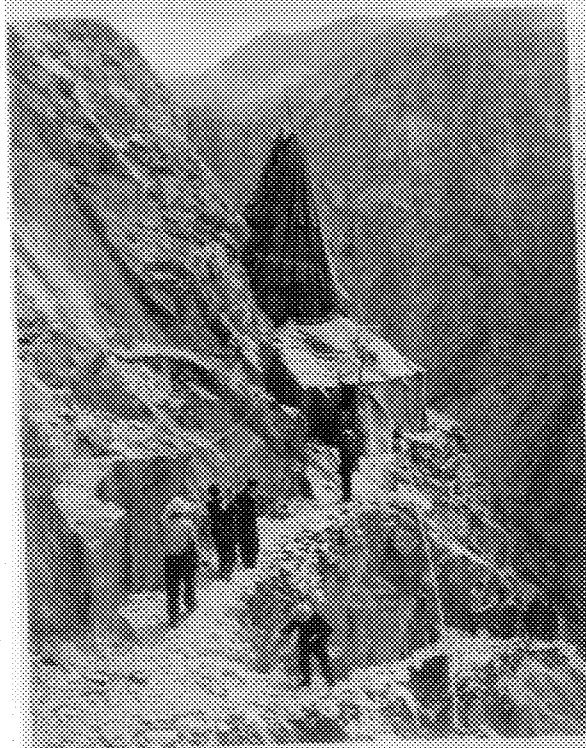


Figure 2 Iron ore geological survey team in Chin-tieh-shan area,
Kansu Province, 1957

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Because of the deterioration of the domestic economy, construction of the iron and steel plant at Chiu-ch'uan probably ceased during 1961 before the first blast furnace was completed, thus, it is doubtful if any iron ore has been mined at Chin-tieh-shan. 2/ Moreover, any large scale development of the reserves will be contingent upon the installation of ore dressing capacity. As of the end of 1962, no information was available indicating such construction was being contemplated.

Additional new iron ore resources reported by the Communists include small hematite deposits at Chang-yeh (38°56'N; 100°39'E) and Yung-chang (38°17'N; 102°07'E) in the Hohsi corridor which were opened in 1958, and a 6 million ton magnetite deposit at Ching-ning (35°32'N; 105°29'E) located about 100 miles east of Lanchow in south Kansu.

Most of the remaining reserves, all of which were known before 1949, consist of small deposits of high grade hematite located at Ch'eng-hsien (33°42'N; 105°36'E) near the Shensi border and at Lanchow. The former was the only deposit being mined prior to the Communist takeover. In addition, small deposits of iron ore are found along the Yellow river in the Ningsia autonomous region, of which the reserves in the P'ing-lo area (38°56'N; 106°34'E) may be the most significant.

Production of iron ore in Kansu may have reached a peak of about 1.7 million tons in 1960. All of the ore came from 9 small and medium mines and was consumed in small blast furnaces which produced a possible 700,000 tons of poor quality pig iron. 3/

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b. Coking Coal

Since 1955, the Communists have carried out surveys for coking coal in Kansu province, particularly in the Ho-hsi corridor region; however, no information concerning total coking coal reserves has been released. Nevertheless, data which have become available on individual deposits indicate that Kansu probably has greater reserves of coal of coking quality than any other province in northwest China.

Probably the most significant deposit, reported by the Chinese in 1957, is located in northern Kansu at Wa-hu-ssu (39°46'N; 98°53'E), near the large Chin-tieh-shan iron mine and the planned Chiu-ch'uan iron and steel plant. The Communists claim reserves of coking coal at Wa-hu-ssu are sufficient to meet anticipated requirements of the Chiu-ch'uan plant. 4/ As of the end of 1962 little if any coal had been mined. Elsewhere in the Ho-hsi corridor substantial reserves of coking coal are found at Shantan (38°45'N; 101°15'E), where several underground mines have been opened since 1957. See photograph, Figure 3. Total coal reserves of 100 million tons are claimed at Shantan with a large portion being of coking quality. Coal from Shantan has been used in coke ovens at a small nearby iron and steel plant and some probably is shipped by rail to a coke plant in Lanchow.

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CHINA KANSU SHAN-TAN 35 45 N 101 15 E
ON-LINE SHAFT NO. 1 AT SHAN-TAN COAL MINE, CHINESE COMMUNIST
SOURCE, OFFICIAL USE ONLY (14) CIA 350715

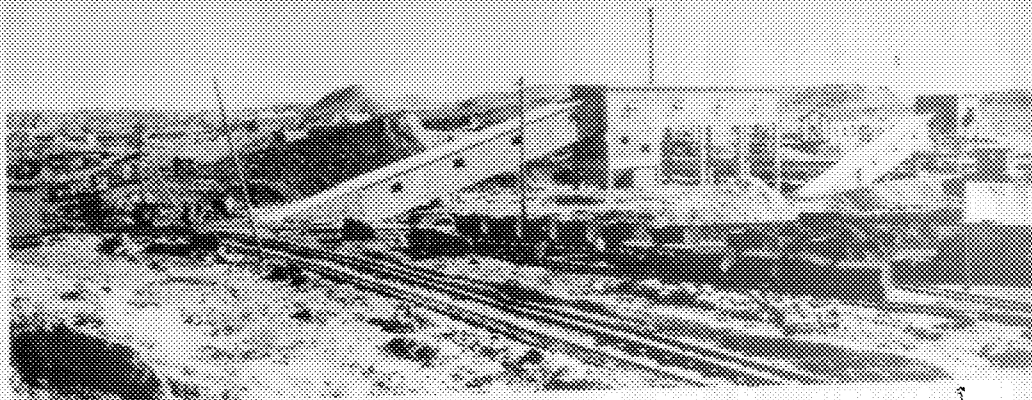


Figure 3 Underground coal shaft and tipples, Shantan, Kansu Province

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Other coking coal resources in Kansu consist primarily of two small deposits in the southern part of the province at A-kan-chen (35°57'N; 103°49'E) and T'ien-shui (34°35'N; 105°33'E). The former deposit is located south of Lanchow and with an output of 40,000 tons annually was the principal producer of coking coal in Kansu before WWII. Output under the Communists is unknown ~~but probably has approximated the former level.~~ Construction of a spur rail line from Lanchow to A-kan-chen was completed during the first Five Year Plan. Coal mined at T'ien-shui near the Shensi border ~~is~~ coked in a small coke plant in that city.

In the Ningsia autonomous region at Shih-tsui-shan (39°10'N; 106°45'E) is found one of the largest coal fields in northwest China with claimed reserves of over 8 billion tons, some of which reportedly is of coking quality. ^{5/} The reserve area is located on the upper reaches of the Yellow river in the eastern foothills of the Ho-lan mountains and occurs in both Inner Mongolia and Ningsia. Coal from Shih-tsui-shan is shipped ~~both~~ ² by rail ~~and the Yellow river~~ ² southwest to Lanchow and northeast to the large iron and steel plant in Paotou, Inner Mongolia.

Output of coking coal and coke in Kansu province probably amounted to about 1,000,000 and 700,000 tons, respectively, in the peak year of 1960--excluding a small amount of coking coal mined at Shih-tsui-shan in Ningsia for shipment to Paotou. Approximately 200,000 tons or 30 percent of the total coke output was produced in 31 "Red Flag" coke ovens

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constructed in 1959. 6/ Most of the remaining coke production came from native coke plants built principally during 1958.

2. Sinkiang

a. Iron Ore

The Chinese have released no figures on total iron ore reserves in Sinkiang; limited information, however indicates total possible reserves well in excess of 150 million tons with much of the ore reportedly being of good quality. While not large, reserves of this magnitude are more than adequate for known requirements of the province.

The first organized geological surveys of Sinkiang, an area almost one-fourth the size of the continental United States, were carried out by the USSR during the late 1930's. Although the Soviets were primarily interested in discovering new sources of strategic minerals such as uranium, gold and nickel, the surveys also revealed rather widely scattered deposits of iron ore, with the largest located at T'acheng (46°45'N; 82°57'E) in northwest Sinkiang. No estimate of overall iron ore reserves was reported by the Soviets, and very little if any ore was mined before the pressures of WW II caused the USSR to suspend activities in Sinkiang early in 1943. After WW II, the USSR resumed its policy of economic exploitation in Sinkiang. In 1950, however, the activities of the Soviets were restricted by a treaty

between Moscow and Peiping that set up a Sino-Soviet joint stock company under which the exploration and production of petroleum, coal and various minerals and metals, principally nonferrous, became a joint responsibility of the two countries. In 1955, control of the stock company was transferred to the Communist Chinese.

During the latter part of the First Five Year Plan (1953-1959) Communist China initiated the first comprehensive survey program specifically for iron ore to be carried out in Sinkiang. 7/ By 1958, the Chinese claimed to have discovered reserves of good quality hematite ore at Khotan (37°07'N; 79°55'E) on the northern slopes of the Kunlun mountains in southwest Sinkiang and in the I'ning area (43°55'N; 81°14'E) of the I'li river valley in northwest Sinkiang. In addition, magnetite deposits of unknown size and quality were reported at Pa-li-k'un (43°35'N; 92°51'E) near the city of Hami in northeast Sinkiang and new reserves of hematite were indicated at the previously known T'a-ch'eng deposits. Except for Pa-li-k'un, however, none of these deposits are located near rail facilities and little mining activity has been carried out.

Production of iron ore has been small in Sinkiang reaching an estimated maximum of 400,000 to 500,000 tons in 1960, approximately 75 percent of which was consumed in several small and medium blast furnaces at the "August First" iron and steel plant in Urumchi. This small integrated plant, the only iron and steel facility of importance in Sinkiang, was put into operation in the early 1950's and by 1960 had an annual capacity

of about 150,000 tons of pig iron, 100,000 tons of crude steel and 70,000 tons of finished steel. The iron ore consumed at Urumchi is transported by truck from small nearby mines, most of which have been operated for a number of years and are located at T'o-k'o-hsun (42°47'N; 88°38'E), Fu-yuan (43°59'N; 89°03'E), Chang-chi (44°01'N; 87°19'E) and Fou-k'ang (44°10'N; 87°59'E). Most of the remaining iron ore output in 1960, all of which came from small newly opened local mines, was consumed in a number of small furnaces built primarily during the 1958-60 period in the Kashgar (39°29'N; 75°58'E), Kuldja (43°34'N; 83°09'E) and Hami (42°48'N; 93°27'E) areas.

b. Coking Coal

Most of the known coking coal in Sinkiang occurs in two parallel discontinuous belts on the northern and southern slopes of the Tien-shan mountains, ranging from Hami in the east to Wu-ch'ia (39°48'N; 74°15'E) near the Soviet border in the west--a distance of approximately 900 miles. 8/ The largest and best quality reserves are found in the eastern end of the coal bearing region in the Hami district with substantial reserves also reported in the vicinity of Urumchi. Coking coal reserves in the latter two areas were placed at over 300 million tons in the late 1950's. Although figures on total reserves of coal of coking quality in Sinkiang have not been released, available information suggests that reserves are more than adequate for anticipated iron and steel industry requirements.

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Output of coke in Sinkiang probably reached a peak of about 200,000 tons in 1960 with the bulk being produced in native and beehive ovens in the Urumchi area using coal from three local mines. Much of the coal in the latter area is high in sulphur, and a small coal washing plant, the first in Sinkiang, was put into operation in Urumchi during 1960. 2/ Small amounts of coke also have been produced in west Sinkiang, primarily in the vicinities of Kuldja and Kashgar.

3. Shensi

a. Iron Ore

Shensi with possible reserves of only 50 million tons has the smallest resources of iron ore of any province in northwest China. Some ore is found in the Chen-an (33°24'N; 109°12'E) area south of Sian, however, most of the deposits are located in the relatively inaccessible Tsin-lien mountains north of the Han river in southwest Shensi within a 50 mile radius of Mien-hsien (33°11'N; 106°36'E). The bulk of the ore, consisting of limonite and hematite, occurs in irregular pockets, frequently associated with quartzite and has an iron content ranging from 38 to 58 percent. Prior to 1956 much of this region was accessible only by pack animal. The opening of the Paochi-Chengtzu railroad in that year, however, signalled the start of the first organized survey and exploitation of mineral resources in this area, including iron ore.

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Very little ore was mined before the small blast furnace campaign that started in 1958. In that year the Chinese opened several primitive mining operations and by 1960 were obtaining ore from 25 small open-pit mines. ^{10/} Output reached a peak of an estimated 300,000 tons of iron ore in 1960, roughly half of which was consumed locally in small blast furnaces, with most of the remainder being shipped by rail to Sian and Paochi for use in small pig iron plants built during 1958-59. Total Shensi pig iron production reached a maximum of about 120,000 tons in 1960.

b. Coking Coal

In contrast to iron ore almost all of the known coking coal in Shensi lies north of the Wei river in the central and northern portions of the province. The bulk of the coking coal occurs in the eastern end of what the communists call the "Black Belt", a 200 mile long coal bearing region that extends across central Shensi from Hancheng (35°28'N; 110°29'E) in the east to Lung⁶hsien (34°51'N; 106°40'E) in the west. Total coal reserves in the "Black Belt" may amount to 5 billion tons with an unknown, but reportedly significant, portion consisting of coal of coking quality. Most of the known coking coal resources are concentrated in the Tung-chuan (35°00'N; 109°07'E) area about 65 miles west of the Shansi border where limited mining activity was carried out many years before the Communist takeover. ^{11/}

In 1957, the Chinese began an extensive geological survey both in the Tung-chuan area so as to more clearly define existing coking coal resources and in south Shensi in an effort to locate coal of coking quality near the province's reserves of iron ore. The only new coking coal discovered as a result of these surveys was a small deposit at Shang Hsien (33°49'N; 109°56'E) approximately 55 miles southeast of Sian. Moreover, a heavy cover of loess over much of north and central Shensi has made it very difficult for the Chinese to determine accurately the extent of coking coal resources in the Tung-chuan region. No figure on reserves has been released either for individual deposits or for the province.

Output of coking coal and coke, minimal as late as 1957, reached a maximum level in 1960 of approximately 2 million and 1.2 million tons, respectively. ^{12/} Most of the coal and a large portion of the coke were produced in the Tung-chuan mining area where several new shafts, coal dressing facilities, and native coke oven plants were put into operation during the 1958-60 period. Coking coal from Tung-chuan, also, is shipped to small coke plants in Sian and Paochi.

4. Tsinghai

a. Iron Ore

Data on total reserves of iron ore in Tsinghai province have never been released by the Chinese but limited information indicates reserves probably exceed 150 million tons. Reserves of this size are of

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roughly the same magnitude as those in Sinkiang but probably of a poorer overall quality. Although small deposits of iron ore are widely scattered throughout Tsinghai, the bulk of the known ore is found in three reserve areas located near Hsi-ning (36°37'N; 101°56'E) in east Tsinghai, Golmo (36°22'N; 94°55'E) in central Tsinghai, and in the Tang-ku-la mountains in south Tsinghai; the deposits in the latter two areas probably being the most significant. 13/

Little geological prospecting had ever been carried out in Tsinghai before the Communist takeover, principally due to a lack of transportation facilities which in most of the province outside of the eastern area consisted essentially of caravan trails. Construction of new roads during the first Five Year Plan, however, particularly in central and to a lesser extent south Tsinghai, enabled the Chinese to begin a rather extensive geological survey program.

Probably the most important resources of iron ore discovered by the Chinese occur in the Tsaidam Basin, in the northern foothills of the Kunlun mountains extending eastward from Golmo to as far as possibly Shang-ko (36°00'N; 97°47'E). Preliminary estimates, released by the communists in 1959, place reserves in this region as high as 100 million tons of iron ore. The quality of the ore has not been reported suggesting that much of it probably is poor. Access roads were built into the mining area in 1959 and ore has been mined for use in small furnaces.

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The second largest reserve of iron ore reported by the communists is located on the Tsinghai-Tibetan border in the Tang-ku-la mountains. First announced in 1955, survey activity is known to have continued into the Second Five Year Plan. However, insufficient data are available to accurately locate the deposits or to determine their size and quality, beyond statements by the Chinese that the deposits contain sufficient reserves to warrant construction of an iron and steel plant. This rugged mountainous region is far removed from consuming markets and adequate transportation thus any extensive exploitation of the iron ore probably will not occur for many years.

Approximately fifty percent of the estimated 200,000 tons of iron ore mined in Tsinghai in the peak year of 1960 came from several small mines opened since 1957 in the vicinity of Hsi-ning and was consumed in small blast furnaces in that city. Although the principal producing area, reserves of iron ore in this region probably are not large.

Output of pig iron reached a maximum of about 75,000 tons in Tsinghai during 1960. All of the iron was produced in newly constructed small furnaces located principally in the Hsi-ning area and in the Tsaidam Basin.

b. Coking Coal

Prior to 1949, less than 50,000 tons of coal were mined annually in Tsinghai. None of the coal was of coking quality and all of it came from small deposits worked on the average of three months a year

Elsewhere, deposits of coking coal are found in the Ta-ch'ai-tan (approx. 37°45'N; 95°15'E) and Te-ling-ha (37°20'N; 96°50'E) areas along the northern part of the Tsaidam Basin with reserves at the former possibly being the most significant. It is probable that both coking coal and coke have been produced in these areas.

The only known coking coal located outside the Tsaidam Basin is in Huang-chung Hsien (36°31'N; 101°40'E) a few miles southwest of Hsi-ning in eastern Tsinghai. Tung-kou is the principal mine and this relatively modern underground facility, that was expanded in 1960, produced a significant portion of the province's peak coking coal output of an estimated 100,000 tons achieved in that year. In addition, some coking coal may be obtained from mines under the Ta-t'ung (37°05'N; 101°35'E) Mining Bureau located approximately 30 miles north of Hsining.

B. Southwest China

1. Szechwan (including Tibet)

a. Iron Ore

The largest known reserves of iron ore in western China are found in Szechwan province which, historically, also has been the leading producer. Pre-communist geological surveys, limited principally to the more accessible parts of the province known as the Szechwan basin, indicated total reserves of less than 100 million tons of iron ore. Under the Communists a comprehensive prospecting program was started during the first Five Year Plan and several new large reserve areas have been

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reported since 1955, principally in the mountainous southwestern and northeastern sections of Szechwan. As a result, total reserves of iron ore in the province have been estimated by the Chinese as approximating 1 billion tons. ^{15/} However, except for a few small high grade deposits much of the ore is of poor quality containing about 40 percent iron with a considerable portion, also, being high in silica, requiring large investments in beneficiating facilities. In this connection, Communist press announcements in mid-1961 indicated that construction of 10 small "standardized" ore-dressing plants, each with an annual capacity of 50,000 tons of dressed ore, was scheduled to be completed by the end of that year. No indication of their status was available as of the end of 1962.

Output of iron ore in Szechwan reached a maximum of about 6 million tons in 1960 and was consumed in the production of a claimed 2.3 million tons of pig iron--300,000 tons of which were produced in Chungking and 2 million tons in a large number of small iron plants scattered throughout the province. In 1960, close to one-half of the small furnace pig iron was shipped to Chungking for use in steelmaking. Crude steel output in Chungking, the largest producer in southwest China, amounted to an estimated 1.2 million tons in 1960.

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The oldest producer of iron ore in Szechwan is the Chi-chiang (28°54'N; 106°39'E) mining district located about 40 miles south of Chungking with direct rail connections to that city on the partially completed Szechwan-Kweichow rail line. The area consists of three underground mines which according to incomplete pre-communist surveys contained from 10 to 20 million tons of hematite ore, high in silica and phosphorus, with an iron content of 38-57 percent. Sizeable new reserves reportedly were discovered during the first Five Year Plan and during the 1958-60 period, to support the growing iron ore requirements of Chungking, an expansion program at the mines was carried out. Output in the latter year reached a peak of about 600,000 tons with the bulk being consumed in blast furnaces at the 101 plant in Chungking.

The largest reserves in southwest China and over one-half of estimated iron ore reserves in Szechwan province are found in an area adjacent to Yunnan province in southwestern Szechwan. The Pan-chih-hua (26°29'N; 101°44'E) deposits were discovered in 1955 and contain a possible 650 million tons of magnetite ore averaging about 40 percent iron, of which 250 million tons reportedly have been proved. 16/

Although some iron ore was known in this general area under the Nationalists no comprehensive prospecting had ever been carried out. Based on the Pan-chih-hua reserves the Chinese early in 1958 announced plans to construct a major iron and steel plant in Hsi-ch'ang (27°54'N; 102°16'E) 100 miles north of the deposits, and in the same year

construction of the Chengtu-Yunnan rail line which will pass through both Hsi-ch'ang and the reserve area was started. Little information has become available on this area since 1959; however, its development undoubtedly will be delayed until sometime after the current industrial slump in China has been overcome.

The second largest reserve of iron ore occurs in the northeastern part of the province in the P'ing-wu ($32^{\circ}25'N$; $104^{\circ}35'E$) area west of the Paochi-Chengtu railroad on the upper reaches of the Fou river. Discovered in 1956, the Chinese announced in 1957 that preliminary estimates placed reserves in this area at about 100 million tons with the possibility of total reserves, after further survey work, being substantially greater. ^{17/} No information relating to the quality of the ore has been released other than much of it is associated with manganese. Ore has been mined for local use. Scattered deposits of iron ore also are found in an area ranging from P'ing-wu south along the Fou river to Mien-Yang ($31^{\circ}28'N$; $104^{\circ}46'E$) with the most significant probably being at Chiang-yu ($31^{\circ}53'N$; $104^{\circ}47'E$) where output amounted to over 200,000 tons in 1960 all of which were consumed locally in ^{medium-size} small blast furnaces.

In east Szechwan a number of small deposits are located along the Yangtse river in the Wan-hsien ($30^{\circ}49'N$; $108^{\circ}24'E$) district near the Hupeh border. Although total reserves probably are not large the quality of the ore, consisting of hematite and some siderite, may be good.

Underground mining for local use has been carried out in this area since before WW II and has been expanded under the Communists.

Elsewhere in Szechwan, substantial quantities of siderite ore have been mined and smelted locally in an area northwest of Wei-yuan (29°33'N; 104°39'E). Also, high grade hematite ore is mined at deposits near Fou-ling (29°43'N; 107°24'E) and Tao-fou (31°00'N; 101°09'E) with much of it being shipped to Chungking for use in open-hearth furnaces.

In Tibet, limited geological survey activity carried out primarily since 1957 has revealed small quantities of iron ore in the Brahmaputra river valley from Zhikatse (29°15'N; 88°53'E) in the west to Lhasa (29°39'N; 91°06'E) in the east, the largest and best quality reserves probably being located in the latter area. Although, prospecting is continuing no information has been released concerning total iron ore reserves in Tibet and output has been restricted to limited amounts mined in the Lhasa area to supply a small blast furnace that operated sporadically in that city from October 1960 till about mid-1961. 18/

b. Coking Coal

Total coal reserves in Szechwan are substantial, amounting to possibly 10 billion tons, with a large but unknown portion being bituminous of coking quality. 19/ Although reserves are sizeable, much of the coal is poor in quality being particularly high in sulphur and ash. Practically all of the known coking coal resources are located in the eastern half of the province, with the bulk occurring in the

southeastern portion of the Szechwan basin in the general vicinity of Chungking. Most of the coal is obtained from underground mines, the larger being mechanized. To upgrade the quality of the coal for coking purposes at least two of the major mines have been equipped with coal washing facilities and, in addition, the Chinese announced in mid-1960 that fifteen small "simplified" washing plants had been constructed in various coking coal producing areas--in some cases supplementing existing larger facilities.

Estimated output of metallurgical coke in Szechwan, based partially on coke requirements for the production of pig iron, reached a peak of 2.0 to 2.5 million tons in 1960 of which about 500,000 tons were produced in modern byproduct batteries with the remainder coming from beehive, native and "Red Flag" ovens. Possibly 1.5 million tons of the total, including most of the byproduct coke, were produced by the Chungking iron and steel company. See photograph, Figure 5. Limited data on principal mines suggest output of coking coal was more than sufficient to support estimated coke output and complaints in the press indicate uneconomic use of coking coal in some areas for household heating.

The principal supplier of coking coal in the Chungking district is the Chung-liang-shan mining area located a few miles southwest of the city. A new reserve of 2.4 billion tons of coal was reported in the mid-1950's and by the end of 1959 two large underground mines had been put into operation, each with a claimed annual capacity of 900,000 tons.

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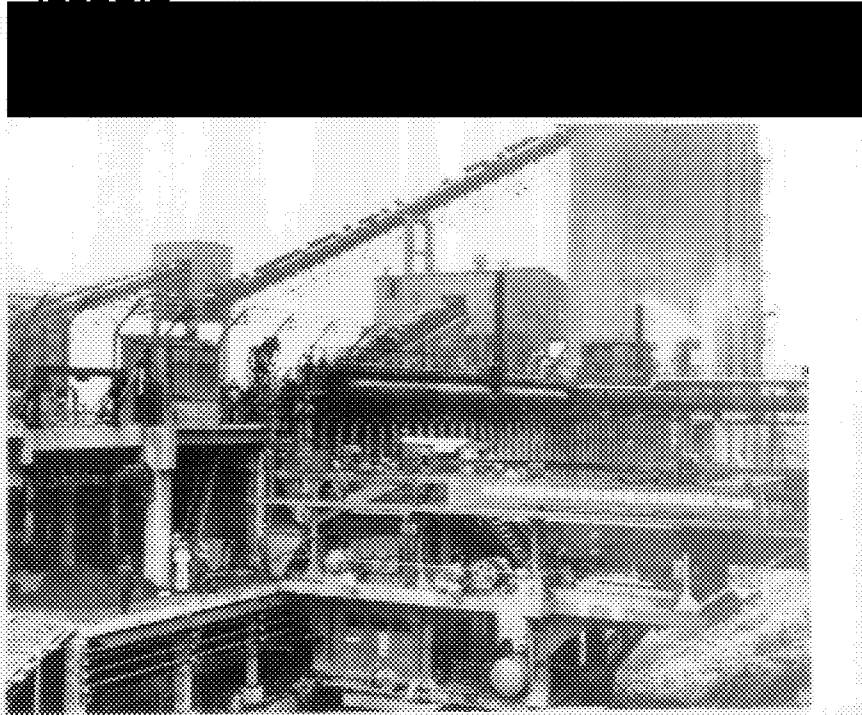


Figure 5 Modern byproduct coke oven battery put into operation in Chungking in January 1960

The bulk of the coal reportedly is of coking quality but high in both sulphur and ash. Coal washing facilities capable of washing 1.8 million tons a year were completed in the area in 1959.

One of the oldest producers of coal, including coking coal, in southwest China is located about 40 miles southeast of Chungking in the vicinity of Nan-chuan (29°07'N; 107°16'E) and is known as the Nan-tung mining district. Total coal reserves in this area exceed 300 million tons of which an unknown portion consists of coal of coking quality that is high in sulphur. That reserves of coking coal probably are significant is indicated by the completion of a new modern underground coking coal mine called Yu-tien-pao in mid-1959. This mine, with a capacity of 1.2 million tons a year, supplies coal to Chungking and to a small byproduct coke plant built in the mining area prior to the Communist takeover.

Elsewhere in the Chungking vicinity, coking coal resources are found about 40 miles northwest of the city in the Pei-pei (29°50'N; 106°26'E) area, on the southern bank of the Chia-ling river. Designated the Tien-fu mining district this area has total coal reserves of over 400 million tons, a large portion of which is of coking quality. Much of the coal is low grade, however, being quite high in sulphur and ash. Tien-fu is equipped with coal washing facilities and two small coke plants, one built by the Communists since 1958.

Outside of the Chungking area, coking coal is mined in a number of locations generally in association with small pig iron producing facilities. The more significant deposits include those in the Ta^hhsien (31°16'N; 107°31'E) and Chiang-yu (31°53'N; 104°57'E) areas in northeast and north-central Szechwan, respectively. Red Flag coke plants are located in both areas. Coking coal and coke also are produced in the south-central part of the province in the vicinities of Wei-yuan (29°33'N; 104°39'E) and Huang-tang (29°10'N; 103°44'E).

Very little is known about coal resources in Tibet. Although some survey work has been carried out, the only coal reported by the Chinese to be of coking quality is located in the Tumagala area near the Tangkula (33°00'N; 92°00'E) mountains in remote northern Tibet. Reserves and quality of the coal are unknown.

2. Yunnan

a. Iron Ore

Reserves of iron ore in Yunnan probably are the smallest and poorest in quality in southwest China. Most of the ore occurs in a series of scattered deposits in the northwestern and central parts of the province with those in the latter district being of the best quality. Limited pre-communist surveys of the more accessible deposits indicated reserves of about 40 million tons of ore. In addition, it was indicated that rather large quantities of poor quality ore also existed for which

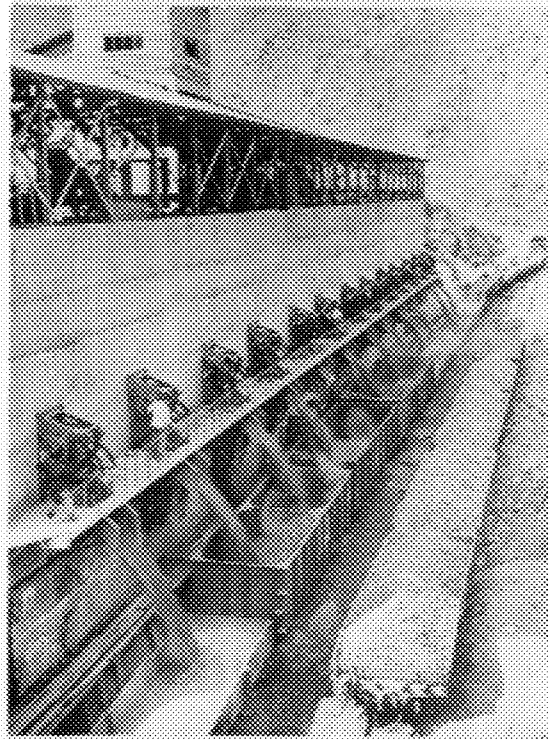
no reserve estimate was given. In 1960 the Communists placed total possible reserves of iron ore in Yunnan at about 500 million tons, based on surveys carried out during the preceding several years. It was noted, however, that the bulk of the ore, consisting principally of hematite, was of poor quality containing less than 40 percent iron. 20/

Output of iron ore reached a maximum level of possibly 1.2 million tons in Yunnan during 1960 and was consumed in the production of at least 400,000 tons of pig iron, a large portion of which was produced in the vicinity of Kunming (25°04'N; 102°41'E).

The primary producer of iron ore in Yunnan is the Wang-chia-tan open-pit mine located at Pa-chieh (24°40'N; 102°20'E) about 40 miles southwest of Kunming. 21/ The mine is located within an iron ore reserve area bounded by I-men (24°40'N; 102°09'E), Kun-yang (24°40'N; 102°35'E) and O-shan (24°11'N; 102°24'E), known before WW II. Incomplete pre-1949 surveys indicated that reserves in this area were not large, amounting to less than 25 million tons, but did contain the best quality ore in the province. The ore consists of hematite and some limonite ranging in iron content from 48 to 60 percent that is low in sulphur and phosphorus and low to moderate in silica. Under the Communists this district was thoroughly surveyed and press announcements indicate total reserves may amount to about 50 million tons. The Wang-chia-tan mine is the principal supplier of ore to a small integrated

plant at Anning ($24^{\circ}56'N$; $102^{\circ}30'E$), about 15 miles west of Kunming, which has an annual capacity of about 300,000 tons of pig iron and 160,000 tons of crude steel and is the only iron and steel facility of significance in Yunnan. Ore also has been supplied to small furnaces in I-men, a traditional center of native iron production in the province. As a result of an expansion program carried out at the mine between 1957 and 1960, which included construction of a mechanized ore dressing plant, output of iron ore may have amounted to about 1 million tons in the latter year. See Photograph, Figure 6.

The largest reported reserves of iron ore in the province are located about 40 miles northwest of Kunming at Wu-ting ($25^{\circ}33'N$; $102^{\circ}26'E$), in the Ch'u-hsiung Autonomous Chou. Small amounts of ore long have been mined in this area for use in native iron production and limited pre-communist data placed reserves at 6 to 18 million tons. In mid-1958, however, the Chinese announced the discovery of a large new deposit that was estimated to contain 100 million tons of ore. The ore probably is hematite with an announced iron content of less than 50 percent with much of it averaging no more than 30 percent. 22/ Output has been limited to small amounts for local use and any large scale exploitation would necessarily be dependent upon the construction of extensive beneficiating facilities. There has been no indication by the Chinese that such facilities are planned.



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Figure 6 Ore loading facilities at the Wang-chia-tan iron mine,
Yunnan Province, 1960

Elsewhere in Yunnan, scattered deposits of iron ore are located in the areas of Shih-ping ($23^{\circ}43'N$; $102^{\circ}30'E$), Ning-erh ($23^{\circ}05'N$; $101^{\circ}03'E$) and Man-lau ($21^{\circ}29'N$; $100^{\circ}38'E$) in the south and southwest and in the Hua-p'ing ($29^{\circ}59'N$; $101^{\circ}10'E$) area in the northwest. The reserve and quality of ore in these areas are unknown but several have supported small native iron producing centers for many years.

b. Coking Coal

Reserves of coal of coking quality in Yunnan are significant, amounting to possibly 2 billion tons, but are smaller than those in Kweichow or Szechwan. Most of the known coking coal occurs in the north and eastern portions of the province where incomplete surveys carried out in the late 1930's and early 1940's indicated reserves of about 235 million tons of relatively good quality bituminous coal moderate in ash and sulphur. More extensive prospecting by the Communists resulted in the discovery of additional coal resources, particularly in eastern Yunnan between Kunming and the Kweichow border. 23/ Because of a lack of rail facilities, most of the coking coal produced in the province comes from mines near Kunming, the principal consuming center, which is linked with the mines by a narrow gauge rail system.

No modern byproduct coke batteries are known to exist in Yunnan. The province's coking capacity, amounting to a claimed 1 million tons annually, consists of native and beehive ovens largely concentrated in the Kunming district.

The best quality coking coal in the province is found at I-ping-lang (25°06'N; 101°53'E) about 70 miles west of Kunming. Although reserves ^{probably are not extensive,} ~~are small, probably not exceeding 10 million tons,~~ the ash and sulphur content of the coal is quite low. The mine has had beehive coke producing facilities for many years and prior to 1959 most of the coke was used locally. In that year, however, a rail line from I-ping-lang to Kunming was opened allowing movement of coke and coal to that city.

Also, this district probably is the principal supplier of coke to the nonferrous industry in the province, particularly the tin and lead producing area at Ko-chiu (23°23'N; 103°09'E) in south Yunnan.

East of Kunming about 30 miles, is located an old coal field known as Ming-liang with reserves of 40 million tons. Most of the coal occurs within a 10 mile area north of the village of I-liang (24°54'N; 103°09'E) east of the Kunming-Haiphong railroad. The deposits consist of bituminous coking coal and lignite with the latter possibly predominating. Coke and coking coal have been supplied to Kunming and to nonferrous smelting facilities.

Elsewhere in the Kunming district, approximately 75 miles southeast of the city, is a coking coal reserve area that has been known for many years. Bounded by Lu-hsi (24°31'N; 103°46'E), Lu-nan (24°47'N; 103°16'E) and Mi-lo (24°24'N; 103°26'E), the coal field in the 1940's was estimated to contain slightly over 100 million tons of low-volatile bituminous coal of coking quality. As a result of surveys during the first Five Year

Plan the Communists claimed total reserves of 150 million tons. Due to a lack of rail facilities, output has been small with the coal being coked at the mines for use in local iron furnaces.

Early in 1958 the Chinese announced that prospecting carried out during the preceding several years had revealed a large reserve of good quality coking coal amounting 1.5 billion tons in Fu-yuan hsien (25°40'N; 104°14'E), some 100 miles northeast of Kunming near the Kweichow border. Reserves of this size, if proved, would constitute the largest resources of coking coal in Yunnan and one of the largest in southwest China. Estimates made before 1949, based on limited surveys, placed reserves at less than 50 million tons with the recognition, however, that much greater amounts were possible. Coal and coke long have been produced in the area for local use, but because of its relatively inaccessible location any extensive exploitation will be dependent upon construction of rail facilities linking the reserve area with the projected Kunming-Kweiyang railroad.

Significant reserves of coal of coking quality, low in sulphur and ash, are located in mountainous northern Yunnan at Yung-jen (26°03'N; 101°40'E) near the Szechwan border. These deposits were discovered and initially surveyed in the late 1930's with reserves estimated at about 100 million tons. Prospecting is known to have been carried out by the Communists, but no additional information concerning reserves has been released. Except for a few native underground workings little coal has

been mined because of the remote location. The reserve area is situated near the scheduled Chengtu-Kunming railroad and probably will serve as the principal source of coking coal for the major iron and steel plant planned for Hsi-chang (27°54'N; 102°16'E) in southwest Szechwan.

3. Kweichow

a. Iron Ore

No information on total reserves of iron ore in Kweichow has ever been released other than announcements by the Communists that deposits are widely distributed throughout the province. However, available data on known deposits indicate possible reserves in excess of 500 million tons, which, although largely of poor quality, would rank Kweichow second in iron ore resources in southwest China, after Szechwan province. ^{24/} Output of iron ore reached an estimated 400,000 tons in the peak year of 1960 and was consumed in a number of small blast furnaces located principally in Kweiyang (26°36'N; 106°50'E), Shui-ch'eng (26°34'N; 104°52'E), Tu-yun (26°16'N; 107°31'E) and Tsun-i (27°42'N; 106°55'E) which produced about 150,000 tons of pig iron.

The best quality ore in Kweichow is located in the Shui-ch'eng area in the northwestern part of the province near the projected Kweichow-Yunnan railroad. The principal deposit known as Kuan-yin-shan is several miles southeast of Shui-ch'eng and according to pre-communist estimates contains about 100 million tons of good quality, limonite ore containing

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58-60 percent iron. This is the largest reserve of such ore in China.

In addition a small deposit of hematite is located at Ma-ku (27°02'N; 104°36'E) about 35 miles northwest of Shiu-ch'eng. Both reserve areas have been traditional suppliers of ore for native iron production in this area and since the mid-1950's the Kuan-yin-shan mine has been expanded to provide ore for a small iron and steel plant constructed in Shiu-ch'eng during the first Five Year Plan.

In northern Kweichow near Tsun-i, an area not known to have been surveyed before the Communist takeover, large reserves of iron ore were claimed to have been discovered by the Chinese in 1958. According to press announcements total reserves substantially exceed 100 million tons of low grade ore which has an iron content ranging from 30 to as high as 50 percent. Deposits occur on the east and west side of the projected Kweichow-Szechwan railroad. Output has been small with any significant development requiring the construction of ore dressing and rail facilities. However, the Chinese have indicated these deposits may one day serve as a supplementary source of ore for the Chungking district located about 130 miles to the north.

The Kaili (26°36'N; 107°58'E) area in southeast Kweichow long has been a center for native iron production using hematite ore from local small non-mechanized open-pit mines. Limited surveys made in the 1930's placed reserves of ore in this area at about 5 million tons. In 1955, the Communists announced that prospecting carried out thus far during

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the first Five Year Plan had revealed much greater quantities of ore than previously estimated and in 1958 claims that total reserves might be as great as 300 million tons were made. Included in these announcements, however, was the notation that most of the ore was poor quality and would require beneficiation. ^{25/} Moreover, only a small portion of the total probably has been proved. The reserve area is near the Kweichow-Kwangsi railroad and has supplied ore to blast furnaces in Tu-yun and Kwei-yang.

Elsewhere in the province, small deposits of ore are found in the extreme east portion of Kweichow in the Chin-p'ing (26°46'N; 109°12'E) area near the Hunan border and in central Kweichow at Ching-chen (26°33'N; 106°28'E) and Chen-ning (26°04'N; 105°46'E), west of Kwei-yang. The Chin-p'ing ore consists of hematite, possibly of good quality, limited production of which has been used in local iron production. The type, quality and reserves of ore at Ching-chen and Chen-ning are unknown.

b. Coking Coal

The largest reserves of coking coal in southwest China are found in Kweichow with the bulk being located in the western portion of the province. Most of the coal occurs in a discontinuous 85 mile long line ranging from Wei-ning (26°51'N; 104°14'E) to Lang-tai (26°06'N; 105°20'E) with the largest reserves being located midway between in the Shui-ch'eng (26°34'N; 104°52'E) area. According to Chinese announcements

in 1958-59 total coal resources in this region amount to about 18 billion tons, over twenty times the 780 million tons estimated for the area in the early 1940's as a result of very limited survey work principally in the vicinity of Shui-ch'eng. 26/ A large but unknown portion of total reserves is bituminous of coking quality, relatively low in sulphur and ash, with the best quality probably being located in the Wei-ning area. Several new mines have been opened in west Kweichow since 1958 but few for the purpose of producing coking coal since provincial demand for such coal has been limited. However, press releases indicate that when rail facilities become available the area will serve as a supplemental source of coking coal for the large steel mill scheduled for eventual construction at Hsi-chang in southern Szechwan some 180 miles to the northwest.

In northern Kweichow, northeast of T'ung-tzu (28°08'N; 106°49'E), near the Szechwan border, bituminous coal of coking quality, but high in sulphur, has been mined for many years. These deposits make up the southern part of the Nantung mining district which extends north to Nan-chuan in Szechwan province, and reserves of coking coal in the Kweichow portion may be significant. Small amounts of coke have been produced in the area for many years, and in 1960 coal washing facilities of unknown type were put into operation.

Elsewhere in Kweichow discovery of coal of coking quality was reported during 1955 in the southeast part of the province, possibly in the Kaili (26°36'N; 107°58'E) area. However, the size and quality of the reserves are unknown.

No information has been released concerning total coke production in Kweichow other than the indication that output has been adequate to meet provincial requirements including the small amounts needed by the nonferrous industry. Total requirements probably amounted to about 250,000 tons in the peak year of 1960, virtually all of which was produced in native and beehive ovens associated with small iron plants. Also, some coking coal and possibly coke probably have moved from north Kweichow into Szechwan.

Appendix A

Iron Ore Deposits and Mines, Northwest and Southwest China

Region Province	Mine or deposit location	Kind of ore	Percent iron content	Possible reserves	(million metric tons)	
						Remarks
Northwest Kansu	Chin-tieh-shan (39°15'N; 98°45'E)	Hematite	40	300		The Chin-tieh-shan reserves were discovered in 1955 and, reportedly, are the largest in north-west China. These deposits ultimately will supply a major iron and steel plant scheduled for construction at Chin-ch'uan (39°46'N; 98°34'E). Output of iron ore by the end of 1962 was negligible.
	Chang-yeh (38°56'N; 100°39'E)	n a	n a	n a		Mine was opened in 1958; reserves and output probably small.
	Yung-ch'ang (38°17'N; 102°07'E)	n a	n a	n a		Mine was opened in 1958 and was producing an annual rate of over 5,000 tons in mid-1961, for use in Yung-ch'ang and probably, also, in small furnaces at Shan-tan (38°45'N; 101°15'E).
	Pai-yin-ch'ang (36°03'N; 103°41'E)	Hematite	58	1.5		Deposit is located in or near Lanchow; output has been minimal.
	Ching-ning (35°32'N; 105°29'E)	Magnetite	n a	6		Deposit was discovered in 1958; no output has been reported; reserves may be larger than shown.
	Ch'eng-hsien (33°42'N; 105°36'E)	Hematite	50	"small"		This was the only deposit in Kansu being mined prior to 1949. Output has been limited to small amounts of ore needed for small local furnaces.

Region Province	Mine or deposit location	Kind of ore	Percent iron content	Possible reserves	Remarks
Northwest Kansu (Cont.)	P'ing-lo (38°56'N; 106°34'E)	n a	40	n a	Deposit located in the Ningsia autonomous region; since 1957 small quantities of ore mined for use in small furnaces.
	Chung-ning (37°35'N; 105°45'E)	Siderite and limonite	n a	3.7	Located in Ningsia autonomous region; output has been small.
	Chung-wei (37°30'N; 105°09'E)	Hematite	n a	2.6	Located in Ningsia autonomous region; output has been small.
Sinkiang	Kashgar area (39°29'N; 75°58'E)	n a	n a	n a	Includes small deposits at Igniz Yar (38°41'N; 76°13'E), Wacha (37°40'N; 75°35'E), and in Wuchia Hsien (39°48'N; 74°15'E) which have supplied ore to small blast furnaces in Kashgar.
	Pai-cheng (41°46'N; 81°52'E)	Magnetite and hematite	n a	30	Ore is found in several deposits northeast of Pai-cheng.
	K'u-che (41°43'N; 82°54'E)	Hematite	30	2.7	Supplied local blast furnaces 1958-60.
	Khotan (37°07'N; 79°55'E)	Hematite	60	n a	This deposit was initially reported in 1958; and probably is the principal reserve area in south Sinkiang; there has been no evidence of any mining activity.
	T'a-ch'eng (46°45'N; 82°57'E)	Hematite	n a	34	Reserves may be much larger than indicated. In 1958, the Chinese claimed the T'a-cheng deposits were the largest in Sinkiang, although, no mining activity has been reported.

Region Province	Mine or deposit location	Kind of ore	Percent iron content	Possible reserves	Remarks
Northwest Sinkiang (Cont.)					
	Aral-Tuba (45°28'N; 83°45'E)	n a	n a	n a	Reserves probably small; limited quantities of ore shipped to Zetta (43°25'N; 83°15'E) for use in small blast furnaces.
	Pa-li-k'un (Chen-hsi) (43°35'N; 92°51'E)	Magnetite	n a	n a	Possibly the best iron ore deposit in east Sinkiang; new reserves were reported in 1958; limited amount of ore shipped to small blast furnaces in Hami.
	T'o-k'o-hsun (42°47'N; 88°38'E)	Magnetite	n a	32	Supplies ore to Urumchi and may also include the Mo-t'o-sha-la mine.
	Fu-yuan (43°59'N; 89°04'E)	Siderite	"high grade"	44	Supplies ore to Urumchi.
	Chang-chi (44°01'N; 87°19'E)	n a	n a	n a	Supplies ore to Urumchi.
	Fou-k'ang-hsien (44°10'N; 87°59'E)	n a	n a	40	Probably supplies ore to Urumchi.
	I'ning (43°55'N; 81°14'E)	Hematite	50	n a	Supplied locally constructed small blast furnaces 1958-60; claims by the Chinese in 1957 indicate reserves in this area probably are significant.
Shensi	Mien-hsien area (33°11'N; 106°36'E)	Hematite and limonite	42-53	48	Reserve area includes small deposits at Feng-hsien (33°52'N; 106°33'E), Iui-pa (33°38'N; 107°00'E), Lueh-yang (33°20'N; 106°03'E) and Pai-shui-chiang (33°35'N; 105°54'E). Small open-pit mines in this area produced most of the estimated 300,000 tons of iron ore mined in Shensi province in 1960.

Region	Province	Mine or deposit location	Kind of ore	Percent iron content	Possible reserves	Remarks
Northwest	Shensi (Cont.)	Chen-an (33°24'N; 109°12'E)	Limonite and hematite	38-58	2	Output has been small.
		Golmo area (36°22'N; 94°55'E)	Hematite and magnetite	n a	100	Discovered during the Second FYP the iron ore area extends from Golmo eastward possibly to Shang-ko (36°00'N; 97°47'E). Reserves may be much larger than indicated. Output has been small.
	Tsinghai	Hsi-ning area (36°37'N; 101°46'E)	n a	n a	n a	Output of iron ore from local mines may have approximately 100,000 tons in 1960 for use in Hsi-ning. Reserves probably are not large. Nan-men-shan is the principal mine.
		Tang-ku-la-shan (33°00'N; 92°00'E)	Various	n a	n a	The exact location of this iron ore reserve area on the Tsinghai-Tibet border, which was first reported in 1955, is unknown. Reserves probably are significant. Output has been small.
Southwest	Szechwan	Pan-chih-hua (26°29'N; 101°44'E)	Magnetite	40	650	As a result of discoveries made during the first FYP the Chinese claim the largest reserves in southwest China are located in the Pan-chih-hua area. About one-third of the total possible reserves are proved. The deposits ultimately will supply a major iron and steel plant scheduled for construction at Hsi-chang (27°54'N; 106°16'E) one hundred miles to the north. Reserves indicated probably include deposits at Hui-li (26°41'N; 102°15'E), Yen-pien (26°54'N; 101°34'E) and in Ning-nan Hsien (27°07'N; 102°42'E).

Region Province	Mine or deposit location	Kind of ore	Percent iron content	Possible reserves	Remarks
Southwest Szechwan (Cont.)					
	Chi-chiang area (28°54'N; 106°39'E)	Hematite	38-57	n a	Includes the Tu-tai-chang, Pai-shih-tang and Talopa underground mines located within 25 miles of Chi-chiang. Historically, the area has been the principal iron ore producer in Szechwan. Total reserves probably are significant but are high in sulphur and phosphorus. Ore is shipped to Chungking by rail 40 miles to the north.
	Li-chia-shan (unknown)	Siderite	40	n a	Located about 40 miles northwest of Wei-yuan (29°33'N; 104°39'E) this semi-mechanized underground mine is in the Lo-shan special administrative district. Capacity of the mine was expended in 1960.
	Lu-ku (28°18'N; 102°14'E)	Magnetite with some hematite	65	13	An old deposit; mined to supply local furnaces.
	Taofu (31°00'N; 101°09'E)	Magnetite	70	1.4	Located a few miles northwest of Taofu, this high grade deposit has supplied ore to Chungking for open-hearth use since 1954. Some ore used locally in small furnaces.
	P'ing-yu area (32°25'N; 104°35'E)	Probably hematite	n a	100	Discovered in 1956, the reserve area includes Ch'ing-chuan (32°25'N; 104°57'E) and Sung-p'an (32°36'N; 103°36'E). Quality of the ore is unknown but reportedly is associated with manganese. Output has been small. Reserves may be larger than indicated.
	Chiang-yu (31°53'N; 104°47'E)	Hematite	n a	3	Reserves may be larger than indicated. Output in 1960 amounted to over 200,000 tons of ore that was consumed locally.

Region Province	Mine or deposit location	Kind of ore	Percent iron content	Possible reserves	Remarks
Southwest Szechwan (Cont.)	Wan-hsien area (30°49'N; 108°24'E)	Hematite, some siderite	n a	n a	Includes small deposits at Kai-hsien (31°12'N; 108°25'E), Yun-yang (30°55'N; 108°56'E), Feng-chieh (31°02'N; 109°31'E) and Wu-shan (31°05'N; 109°54'E) of which the latter probably are the most significant. Mining is underground and output has been used locally.
Yunnan	Fou-ling (29°43'N; 107°24'E)	Hematite	50 to 56	2.8	Reopened in 1954, the mining area is about 10 miles south of Fou-ling. Supplies open-hearth ore to Chungking.
	Wang-chia-tan (24°40'N; 102°20'E)	Hematite, with some limonite	48-60	50	This mine is also referred to as the Pak-hai, Pa- chieh and Chun-chao mine. Principal supplies to the Anning and Kunning iron and steel plants. Output (1960) amounted to about 1 million tons. Mine has ore dressing plant. Reserves may be larger than indicated.
	Wu-ting (25°33'N; 102°26'E)	Probably hematite	30 to less than 50	100	Reserves reported in 1958; output has been limited to small amounts for local use.
	Ming-erh (23°05'N; 101°03'E)	n a	n a	n a	Ore used locally.
Man-lau	Shih-p'ing Hsien (23°43'N; 102°30'E)	n a	n a	n a	Ore used locally.
	(21°29'N; 100°38'E)	n a	n a	n a	Located near the border of Burma, the mines reportedly were closed down in 1959.
	Hua-p'ing (26°59'N; 101°10'E)	n a	n a	n a	Ore used locally.

Region Province	Mine or deposit location	Kind of ore	Percent iron content	Possible reserves	Remarks
Southwest Kweichow	Kuan-yin-shan (coordinates unknown)	limonite	58-60	100	Deposit located 15 miles southeast of Shui-ch'eng (26°34'N; 104°52'E). Mining is by semi-mechanized open-pit method. Output approximated 100,000 tons in 1960.
	Ma-ku (27°02'N; 104°36'E)	Hematite	64-67	6	The ore has a trace of sulphur and phosphorus and reserves may be larger than indicated. Ore used locally.
	Tsun-i area (27°42'N; 106°55'E)	n a	30-50	100	Includes deposits at Mei-t'ian (27°46'N; 107°28'E) and Tung-tzu (28°08'N; 106°50'E). Reserves may be larger than indicated.
	Kaili area (26°36'N; 107°58'E)	Hematite	n a	300	Includes deposits at Pa-chai (26°12'N; 107°48'E) and Ping-yueh (26°42'N; 107°33'E). Most of the ore is poor quality and only a small portion probably has been proved.
	Chin-p'ing area (26°46'N; 109°12'E)	Hematite	n a	n a	Reserves probably small and includes deposits at Yung-ts'ung (26°04'N; 109°03'E), Tan-chai (26°22'N; 109°12'E) and Ching-chih (27°08'N; 108°44'E).

Appendix B

Coking Coal Mines and Deposits, Northwest and Southwest China

Area	Province	Mine or deposit location	Possible reserves	Coke plant supplied	(million metric tons)	Remarks
Northwest		Kansu				
		Wa-hu-ssu (39°46'N; 98°53'E)	n a	n a		Deposit was discovered in 1957 and will be the principal source of coking coal for the large iron and steel plants scheduled at Chiu-ch'uan. Reserves may be the most significant in Kansu.
		Shantan (38°45'N; 101°15'E)	100	Lanchow		Several shafts opened in Shantan area since 1957. Coking coal is shipped to Lanchow and some is used in Red Flag coke ovens locally. Large portion of reserves reportedly is of coking quality.
		Hei-shan (38°30'N; 103°02'E)	n a	n a		Deposits containing coking coal discovered in 1955. Reserves may be relatively significant.
		A-kan-chen (35°57'N; 103°49'E)	16	Probably Lanchow		Principal pre-World War II producer in Kansu with an output of 40,000 tons annually. Quality of the coal is good and reserves may be larger than indicated. Production under the communists unknown.
		T'ien-shui (34°35'N; 105°33'E)	n a	Pei-tao-fou		Coke from the Pei-tao-fou coke plant is shipped by rail to industrial plants in Lanchow. Production of coking coal and coke are unknown.
		Shih-tsui-shan (39°10'N; 106°45'E)	"large"	Paotou and Lanchow		Located on the Ningsia-Inner Mongolian border. This is reportedly the largest coal field in northwest China. Much of the coal is claimed to be of coking quality. Three shafts were opened in 1959 and coal washing facilities probably were added in 1959-60. Output of coking coal unknown.

		(million metric tons)			
Area	Province	Mine or deposit location	Possible reserves	Coke plant supplied	Remarks
Northwest	Sinkiang	Kash river valley (43°50'N; 83°19'E)	n a	Local	Two native coke oven plants located on both sides of the Kash river. Most of the coke probably used in small blast furnaces at Zecta (43°25'N; 83°15'E) and Kulaja during 1958-60.
		Urumchi area (43°48'N; 87°35'E)	n a	various	Three mines in or near Urumchi that produce coking coal, including the Liu-tao-wan, Szu-tao-ch'a and Hsi-shan mines, the latter of which probably is the most significant. Known coke plants are located at Liu-tao-wan and Hsi-shan which have a combined annual capacity of an estimated 200,000 tons of coke. Total coking coal reserves may be significant.
		Hami area (42°48'N; 83°27'E)	"large"	n a	Reserves are located at Yehmach'uan in Hami hsien and reportedly contain good quality coking coal. Small amounts probably have been mined for use in Hami.
Shensi		Wu-ch'ia (39°48'N; 74°15'E)	n a	n a	Coking coal was being mined in 1958 for use in Kashgar area. Reserves are unknown.
		Tung-chuan (35°00'N; 109°07'E)	"large"	Paochi, Sian	This is an old mining area developed in the 1930's and is the principal coking coal producer in Shensi. Since 1957, several new shafts have been opened and new coal dressing and native coking facilities have been constructed. Reserve area is connected with Sian and Paochi by rail.
		Shang Hsien (33°49'N; 109°56'E)	n a	Hsiung-erh-shan	In 1960 this mine had a capacity of 25,000 tons of coking coal and 17,000 tons of coke, all of which was used locally. Reserves of coking coal probably small.
	Yulin	(38°18'N; 109°38'E)	n a	n a	An old mine; reserves are small and output has been limited.

Area	Province	Mine or deposit location	Possible reserves	Coke plant supplied	Remarks
Northwest	Tsinghai	Ta-ch'ai-tan area (approx. 37°45'N; 95°15'E)	n a	n a	Reserves may be relatively large although the proportion containing coal of coking quality is unknown. Includes mines named Lu-tsao-shan, Yeh-yang, Yu-chia and probably Mao-niu-shan. Those mines containing coking coal are unknown.
		Muli (approx. 37°20'N; 99°20'E)	500	n a	Discovered during the first FYP most of the coal is found on the border between the Tien-chun and Kang-ch'a Hsiens. The proportion of total reserves consisting of coking coal may be significant.
		Te-ling-ha (37°20'N; 96°50'E)	n a	n a	Reserves and output unknown.
		Huang-chung Hsien (36°31'N; 101°40'E)	n a	n a	Located near Hsining, the Tung-kou mine in Huang-chung Hsien is reportedly one of the principal coking coal producers in Tsinghai. This underground mine was expanded in 1960. Reserves are unknown.
		Chung-liang-shan (29°34'N; 106°34'E)	2,400	Chung-king	Two underground mines opened since 1955 a few miles southwest of Chungking. Coal washing plant completed in 1959 because coal is high in ash and sulphur. Combined capacity of mines 1.8 million tons a year. A large portion of total reserves is coking coal.
Southwest	Szechwan	Yu-tien-pao (29°07'N; 107°16'E)	n a	Nan-tung and Chung-king	This underground mine was opened in 1959 with a capacity of 1,200,000 tons a year. Coordinates indicated are for Nan-chuan which is located about 20 miles northeast of the deposit. Reserves of coking coal may be significant but are high in sulphur. Old, small Nan-tung byproduct coke plant located near the mine.

Area	Province	Mine or deposit location	Possible reserves	Coke plant supplied	Remarks
Southwest Szechwan (Cont.)		Tien-fu (29°50'N; 106°26'E)	n a	Local	Coordinates are for Pei-pei. An old underground mining area that has sizeable reserves of coking coal most of which are highly sulphurous. Equipped with washing facilities and two small coke plants.
		Wei-yuan (29°33'N; 104°39'E)	n a	Local	Underground mine located about 10 miles northwest of Wei-yuan. Reserves probably small but of relatively good quality. Coke plant at mine.
		Ta-hsien (31°16'N; 107°31'E)	n a	Local	Mine (underground) is called Erh-lang and probably is located about 15 miles southwest of Ta-hsien. Reserves may be significant but quality is unknown. Coke plant at mine.
		Chiang-yu (31°53'N; 104°57'E)	n a	Local	Using local coal, coking facilities at Chiang-yu iron and steel plant reportedly had an annual capacity of about 100,000 tons of coke in 1960.
		Huang-tang (29°10'N; 103°44'E)	n a	n a	Old underground mine, reserves probably small.
Yunnan		I-ping-lang (25°06'N; 101°53'E)	8	Local	Reportedly best quality, coking coal in Yunnan. Mine has coke plant and ships coal and coke to Kuming via the southern section of the Chengtu-Kuming railroad opened in 1959.
		Fu-yuan Hsien (25°40'N; 104°14'E)	1,500	n a	Large new reserves discovered early in 1958. Quality of coal good. Due to lack of rail facilities output has been limited to local use. Probably includes reserves in the Hsuan-wei (26°16'N; 104°01'E) area.

Area	Province	Mine or deposit location	Possible reserves	Coke plant supplied	Remarks
Southwest		Yung-jen (26°03'N; 101°40'E)	100	None	Discovered in the 1930's, reserves may be larger than indicated. Will supply projected steel plant in Hsi-chang (27°54'N; 102°16'E), Szechwan.
		I-liang (24°54'N; 103°09'E)	40	n a	Possibly less than half of indicated reserves consist of bituminous coal of coking quality. Supplies Kunming.
		Su-hsi area (24°31'N; 103°46'E)	150	Local	Coal is good quality, low in sulphur and moderate in ash.
	Kweichow	Shui-ch'eng area (26°34'N; 104°52'E)	18,000	Local	A significant portion of total reserves, which may be greater than indicated, is of coking quality. Much of the coal is low in sulphur and low to moderate in ash. Both the projected Kweichow-Yunnan and the Kweichow-Szechwan railroads will pass through the reserve area.
		T'ung-tzu area (26°08'N; 106°49'E)	n a	Local	Southern portion of Nan-t'ung coal mining district. The coal is high in sulphur and ash.

Appendix C

Source References

All sources are evaluated RR 2 unless otherwise indicated.

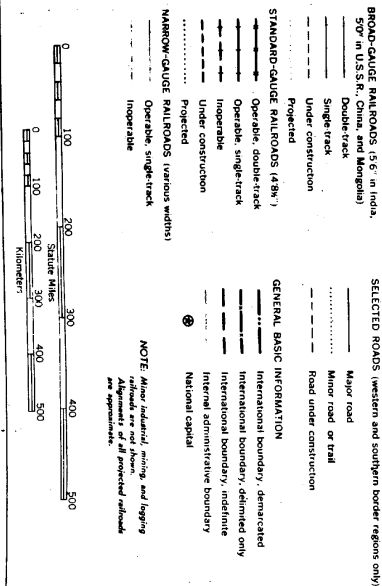
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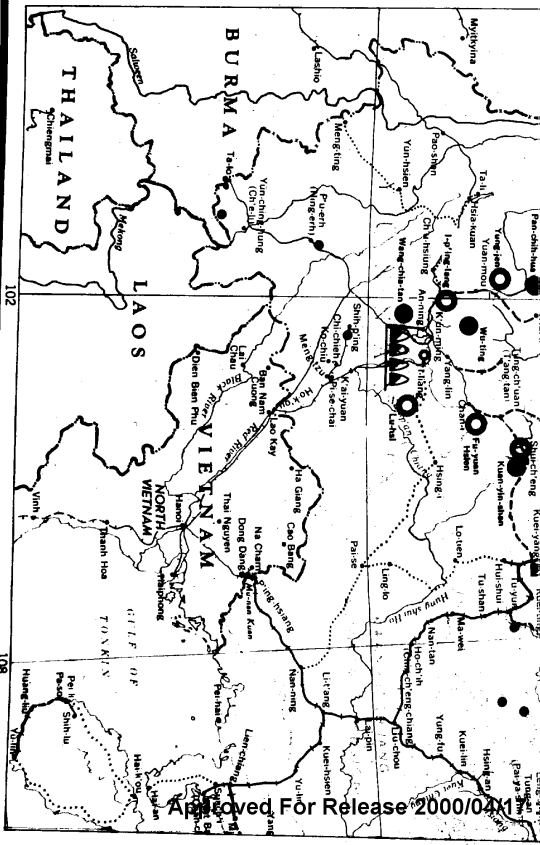
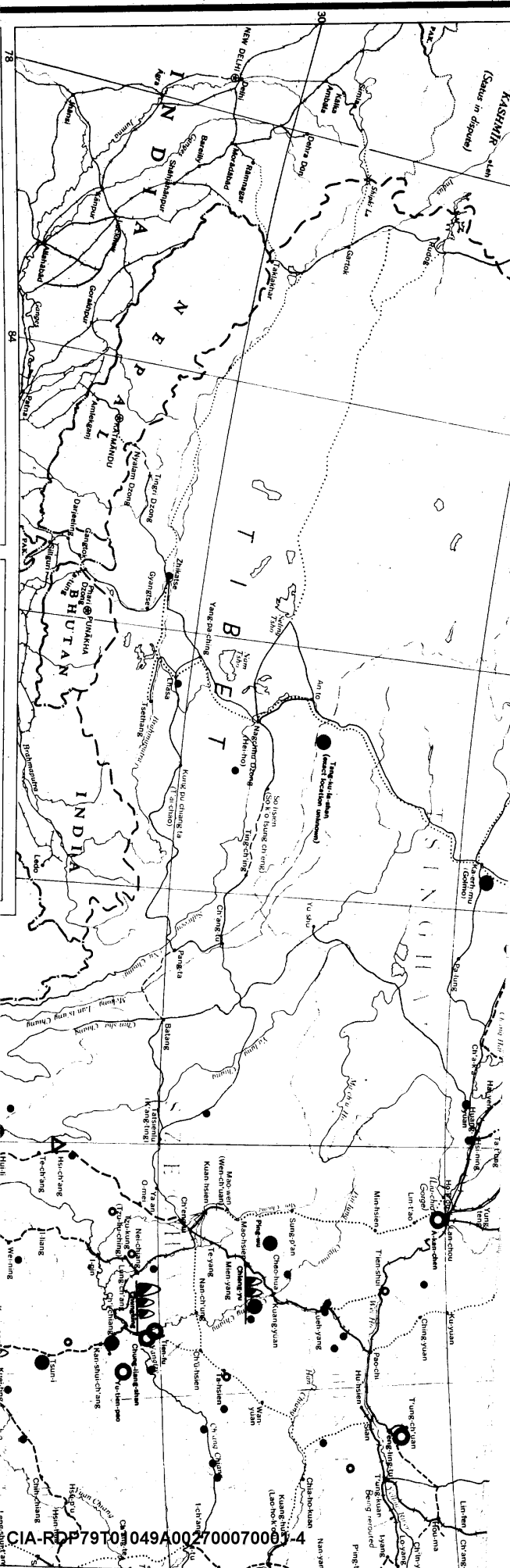
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WEST CHINA MAJOR IRON AND STEEL PLANTS

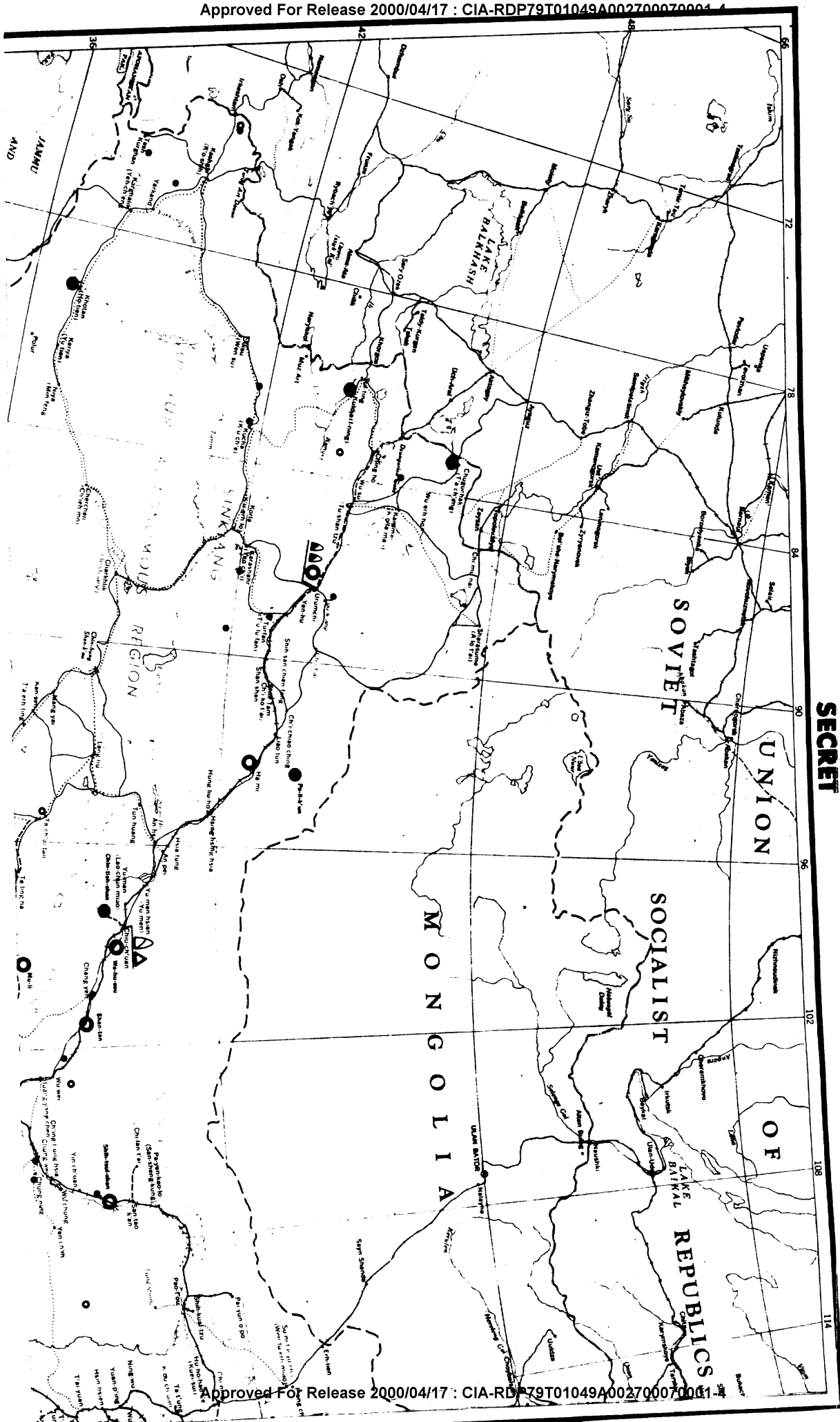


- ▲ Proposed Major Iron and Steel Plant
- ▲ Large Blast Furnace
- ▲ Large Blast Furnace (under construction)
- ▲ Medium Blast Furnace
- Principal Iron Mine or Deposit
- Secondary Iron Mine or Deposit
- Principal Coking Coal Mine or Deposit
- Secondary Coking Coal Mine or Deposit

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